The 2009 Influenza A H1N1 Pandemic
IOM Forum on Microbial Threats
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University of Washington, Seattle
Outline

• Surveillance
• Grappling with uncertainty: Severity
• Mathematical modeling
• Mitigation measures
  – Antiviral drugs
  – School closures
  – Healthcare system response
• Vaccination program
  – Implementation
  – Policy
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Between April 15-17 2009:

- Two cases ILI in children
- Residents of adjacent counties in southern California
- Neither child had contact with pigs
- Virus not detected in swine
- The unusual strain was noticed because the CDC was trying out a new POC diagnostic test at a Navy laboratory and doing more testing than usual through a new Border Infectious Disease Surveillance Project along the Mexican border
Figure 1. Emergency Room Consultations for Pneumonia or Respiratory Infection, Including Influenza-like Illness, at the National Institute of Respiratory Diseases of Mexico.

Patients with the reported cases were admitted between March 24 and April 24 (gray vertical lines). The Ministry of Health issued an epidemiologic alert on April 17 and a full sanitary alert, with closing of schools and cancellation of many public activities on April 23, after it was confirmed that the patients were infected with the novel influenza A (H1N1) virus.
“...it was derived from several viruses circulating in swine, and that the initial transmission to humans occurred several months before recognition of the outbreak...”

“...its gene segments have been circulating undetected for an extended period.”
“...it was derived from several viruses circulating in swine, and that the initial transmission to humans occurred several months before recognition of the outbreak...

“...its gene segments have been circulating undetected for an extended period.”

“Our results highlight the need for systematic surveillance of influenza in swine, and provide evidence that the mixing of new genetic elements in swine can result in the emergence of viruses with pandemic potential in humans.”
Surveillance of Animal Influenza for Pandemic Preparedness

The 2009 H1N1 pandemic was less severe as initially feared. This has led to complacency in some quarters that future pandemics will be of comparable impact and as readily dealt with. However, by September 2009, just 5 months after the recognition of the novel pandemic virus, almost 50% of children in Hong Kong were already infected (1), which reflected the speed of spread of the virus to and from international travel hubs. In most parts of the world, vaccines were not available in time to substantially affect the first wave of disease.

How might we prepare to cope better with future pandemics, particularly ones with greater severity?

No. of avian and swine influenza viral genome sequences available in the Influenza Viral Sequence Database
Influenza virus A was recovered from pigs at 12/53 (22.6%) fairs during the 3-year (2009-2011) sampling period.

Pigs at 10/12 (83.3%) fairs from which influenza virus A was recovered did not show signs of influenza-like illness.

Subclinical influenza virus A infections in pigs at agricultural fairs may pose a risk to human health and create challenges for passive surveillance programs for influenza virus A in swine herds.
Fast spread of swine flu called health emergency

20 PEOPLE INFECTED IN 5 STATES
Cases appear milder in U.S. than in Mexico

By Tony Pugh
McClatchy Newspapers

WASHINGTON — Warning the worst may be yet to come, U.S. officials Sunday declared the rapid spread of swine flu to be a public-health emergency, and the disease, which has now infected 20 people in five states.

On Sunday, Canada became the third country to confirm human cases of swine flu, including two in British Columbia and four in the province of Nova Scotia. Nearly 100 deaths and thousands of illnesses have been linked to swine flu in Mexico, the only place where the flu has killed anyone. Officials there have confirmed the presence of the virus in 22 fatalities.

State is on the watch for cases

Seattle Times staff

No cases of swine flu have been reported in Washington state, health officials said Sunday.

State epidemiologist Tony Marfin said the state is stepping up its disease surveillance at clinics, hospitals and other testing sites to see whether the strain of virus associated with deaths in Mexico can be found here.

“People should be very reassured that the cases reported in the U.S. have been mild,” said Dr. Jeffrey Duchin, chief of communicable disease for Seattle and King County’s public-health department.

“We’re on the watch for it,” state health Secretary Mary Sehulster said.
Figure 2. Distribution of 642 Confirmed Cases of Human Infection with Swine-Origin Influenza A (H1N1) Virus in the United States (May 5, 2009).

There were no cases in the District of Columbia. One case involving a resident of Kentucky occurred in Georgia.
New Influenza A (H1N1),
Number of laboratory confirmed cases and deaths as reported to WHO

Status as of 20 May 2009
6:00 GMT

The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement.

Map produced: 20 May 2009 6:00 GMT
Containing Flu Is Not Feasible, Specialists Say

They Urge a Strategy of Mitigating Effects

By DONALD G. McNEIL Jr.

“Containment is no longer a feasible option,” Dr. Keiji Fukuda, deputy director general of the World Health Organization, announced Monday night in Geneva after a meeting of the agency’s emergency committee on the spreading swine flu virus. “The world should focus on mitigation. We recommend not closing borders or restricting travel.”

Many countries are still ignoring that advice. The globe is a
Pandemic Influenza 2009 H1N1
Emergence and Detection

• Unanticipated local emergence in N. America
  - Need improved surveillance for influenza viruses in swine with potential to cause human infections
• Fortuitous detection of novel strain in humans
  - Enhance human surveillance for novel influenza viruses
• Multiple introductions into/within US before pandemic recognized
  – Source control/border controls unlikely to be effective
  – Minimal data available to inform initial response measures
“Most of Mexico’s dead were young, healthy adults…a World Health Organization (WHO) spokesman said.”

CDC: "The good news is that all of the patients have recovered, and one was hospitalized. This is not looking like a very severe influenza."
The Plans

2005

2006

2007
The Planning Scenario

The Seattle Daily Times

CHURCHES, SCHOOLS, SHOWS CLOSED

AMERICANS AND FRENCH SMASH FOE

6,000,000 DEATHS FROM INFLUENZA

 This is estimate for world, for past 12 weeks.

RECALLS BLACK DEATH

“Flu” five times deadlier than World War.

INFLUENZA PANDEMIC

MORTALITY IN AMERICA AND EUROPE DURING

1918 AND 1919

LONDON, Dec. 18—Canadian Press via Reuter’s—The Times’ medical correspondent says that it seems reasonable to believe that about 6,000,000 persons perished from influenza pneumonia during the past 12 weeks. It has been estimated that the war caused the death of 6,000,000 persons in four and a half years.

Thus the correspondent points out, influenza has proved itself five times deadlier than war. Because, in the same
Human Influenza A H5N1: 60% Case Fatality Rate

Areas with confirmed human cases of H5N1 avian influenza since 2003 *

- **Turkey**
  - Cases: 12
  - Deaths: 4

- **Azerbaijan**
  - Cases: 8
  - Deaths: 5

- **Egypt**
  - Cases: 112
  - Deaths: 36

- **Iraq**
  - Cases: 3
  - Deaths: 2

- **Pakistan**
  - Cases: 3
  - Deaths: 1

- **Bangladesh**
  - Cases: 1
  - Deaths: 0

- **Myanmar**
  - Cases: 1
  - Deaths: 0

- **Thailand**
  - Cases: 25
  - Deaths: 17

- **Viet Nam**
  - Cases: 119
  - Deaths: 59

- **Cambodia**
  - Cases: 10
  - Deaths: 8

- **Indonesia**
  - Cases: 168
  - Deaths: 139

- **Nigeria**
  - Cases: 1
  - Deaths: 1

The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement. © WHO 2010. All rights reserved.

Data Source: WHO
Map Production: Public Health Information and Geographic Information System (GIS)
World Health Organization

* All dates refer to onset of illness
2009 H1N1 Outbreak – Spring and Fall Waves
King County, WA

ED Visits for ILI and Percent of ILI Admissions
Seattle Children's Hospital

ILI visits, %
Admitted, %
CDC’s Aggregate Hospitalization & Death Reporting Activity (AHDRA)

Reported cases per 100,000 population
Standard (Routine) Influenza Surveillance

- Allowed relatively prompt determination that most cases of recognized illness were not severe
- Described age distribution of case
- Approximated hospitalization & death rates
- Local situational awareness re: healthcare system utilization
Morbid Obesity as a Risk Factor for Hospitalization and Death Due to 2009 Pandemic Influenza A(H1N1) Disease

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Abstract

Background: Severe illness due to 2009 pandemic A(H1N1) infection has been reported among persons who are obese or morbidly obese. We assessed whether obesity is a risk factor for hospitalization and death due to 2009 pandemic influenza A(H1N1), independent of chronic medical conditions considered by the Advisory Committee on Immunization Practices (ACIP) to increase the risk of influenza-related complications.

Methodology/Principal Findings: We used a case-cohort design to compare cases of hospitalizations and deaths from 2009 pandemic A(H1N1) influenza occurring between April–July, 2009, with a cohort of the U.S. population estimated from the 2003–2006 National Health and Nutrition Examination Survey (NHANES); pregnant women and children <2 years old were excluded. For hospitalizations, we defined categories of relative weight by body mass index (BMI, kg/m²); for deaths, obesity or morbid obesity was recorded on medical charts, and death certificates. Odds ratio (OR) of being in each BMI category was determined; normal weight was the reference category. Overall, 361 hospitalizations and 233 deaths included information to determine BMI category and presence of ACIP-recognized medical conditions. Among ≥20 year olds, hospitalization was associated with being morbidly obese (BMI≥40) for individuals with ACIP-recognized chronic conditions (OR=4.9, 95% CI 2.4–9.9) and without ACIP-recognized chronic conditions (OR=4.7, 95% CI 1.3–17.2). Among 2–19 year olds, hospitalization was associated with being underweight (BMI≤5th percentile) among those with (OR=12.5, 95% CI 3.4–45.5) and without (OR=5.5, 95% CI 1.3–22.5) ACIP-recognized chronic conditions. Death was not associated with BMI category among individuals 2–19 years old. Among individuals aged ≥20 years old without ACIP-recognized chronic medical conditions death was associated with obesity (OR=3.1, 95% CI: 1.5–6.6) and morbid obesity (OR=7.6, 95% CI 2.1–27.9).
During APR 15 - NOV 13, AI/ANs in 12 states had an H1N1 mortality rate four times higher than persons in all other racial/ethnic populations combined.

Reasons for this disparity might include a high prevalence of chronic health conditions (e.g., diabetes, asthma), poverty (e.g., poor living conditions), and delayed access to care.
Standard Surveillance Methods

Limitations

• Case reporting ascertainment bias:
  – regional & temporal variation in healthcare seeking behavior by age, socioeconomic, and other factors
  – variable testing and reporting behaviors by HCP
  – criteria for hospitalization not standardized or constant over time, vary by age of patient
  – reporting criteria change over time
  – media coverage (emphasis on risk to children)

• Syndromic surveillance (ILI) – nonspecific
• P&I death reporting – not timely
Standard Surveillance Methods

Limitations

• Routine surveillance preferentially identifies severe cases (seeking health care, hospitalization)
  – Asymptomatic and mild cases not reliably identified, true number of infected unknown
  – Hospitalization, case fatality rates are inflated
• Reporting varies by age group (younger persons over represented)
• Reliable data on infection, and clinical infection, rates not readily available

Gaps in Routine Surveillance

Timely rates:
- Infection
- Hospitalization
- CFR

Clinical:
- Clinical course
- Treatment data
- Outcomes

If syndromic:
- Diagnosis
- Etiology
- Risk factors
Gaps in Routine Surveillance Cause:

UNCERTAINTY

UNCERTAINTY

UNCERTAINTY
WHO official denies exaggeration about dangers of swine flu pandemic

By Rob Stein
Friday, January 15, 2010

A top World Health Organization official dismissed charges Thursday that the agency exaggerated the threat posed by the H1N1 virus and that it had been unduly influenced by the pharmaceutical industry to issue dire warnings about the swine flu pandemic.

"The world is going through a real pandemic. The description of it as a fake is both wrong and irresponsible," Keiji Fukuda, the special adviser to the WHO director general on pandemic influenza, told reporters during a briefing. "WHO has been balanced and truthful in the information it has provided to the public. It has informed the world to take appropriate measures in its response to the pandemic."
## WHO Phases of Pandemic Alert

**Lost in Translation: Transmissibility ≠ Severity**

<table>
<thead>
<tr>
<th>Phase</th>
<th>Description</th>
<th>Alert Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inter-pandemic</td>
<td>Low risk of human cases</td>
<td>1</td>
</tr>
<tr>
<td>phase</td>
<td>New virus in animals, no human cases</td>
<td>2</td>
</tr>
<tr>
<td>Pandemic alert</td>
<td>No or very limited human-to-human transmission</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>New virus causes human cases</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Evidence of increased human-to-human transmission</td>
<td>5</td>
</tr>
<tr>
<td>Pandemic</td>
<td>Efficient and sustained human-to-human transmission</td>
<td>6</td>
</tr>
</tbody>
</table>

### Timeline:

- **April 23:** PHEIC declared
- **April 27:** Phase 4: “Significant increase in risk of pandemic”
- **April 29:** Phase 5: “Pandemic imminent”
- **June 11:** Phase 6: Pandemic declared: “moderate severity”
Number of Influenza-Associated Pediatric Deaths by Week of Death: 2006-07 season to present

- **2006-07**: Number of Deaths Reported = 77
- **2007-08**: Number of Deaths Reported = 88
- **2008-09**: Number of Deaths Reported = 134
- **2009-10**: Number of Deaths Reported = 276

Legend:
- Yellow: 2009 Influenza A (H1N1) Deaths Reported Current Week
- Teal: Other Influenza Deaths Reported Current Week
- Pink: 2009 Influenza A (H1N1) Deaths Reported Previous Weeks
- Green: Other Influenza Deaths Reported Previous Weeks
Death and Years of Life Lost From Influenza

Viboud C et al. 2010.

Number of Deaths

2009 Pandemic Preliminary Excess Mortality
Average Seasonal H3N2 Influenza (1979-2001)
1968 Pandemic Excess Mortality
1957 Pandemic Excess Mortality

Courtesy M. Osterholm
Years of Life Lost

- 2009 Pandemic Preliminary Excess Mortality
- Average Seasonal H3N2 Influenza (1979-2001)
- 1968 Pandemic Excess Mortality
- 1957 Pandemic Excess Mortality

Courtesy M. Osterholm
CFR is Key to Determining Response Measures

CDC Interim Pre-Pandemic Planning Guidance (2007)

- “Data on CFR and excess mortality in the early course of the next pandemic will be collected during outbreak investigations of initial clusters of human cases.”
- “However, it is possible that at the onset of an emerging pandemic, very limited information about cases and deaths will be known.”
- “Efforts now (2007) to develop decision algorithms based on partial data and to improve global influenza surveillance systems are needed.”
Mathematical Modeling - 2009 H1N1 Pandemic

Transmission dynamics

• WHO “informal mathematical modeling network”
  – Elucidate transmission dynamics ($R_0$, age specific ARs, $2^0$ ARs, serial interval/generation time, etc).

• Preliminary estimates based on analyses of limited data from early outbreak investigations and surveillance data
  – Early estimates of $R_0$ varied from 1.2 (☹) to >2.0 (OMG)
  – Happily, subsequent investigations led to additional, more consistent, estimates
  – Estimates of HH $2^0$ AR more consistent (18-30%)

• In general, modeling results not timely and characterized by too much uncertainty

WHO. Weekly Epidem Record. 21 AUG 2009.
Kerkhove. Bull WHO 2012
What’s Needed to Maximize Potential from Mathematical Modeling in Pandemic Response?

• Strategies to expedite acquisition of necessary data to inform more timely and precise modeling:
  • Rapid, standardized early outbreak investigations, prospective population based studies
    – EIP; Vaccine Safety Datalink model (HMO-based surveillance)
  • Rapid serological surveys
    – measure age-specific immunity of population over time
    – improve precision of severity measures: quantifying proportion of persons infected, seeking health care, hospitalized, dying
    – inform transmission models
    – difficult to implement
• Systems to monitor for changes in transmission rates over time to assess interventions
• Hospital-based clinical study networks
  – clinical features, pathogenicity, risk factors, treatment response

“Around one child in every three was infected with 2009 pandemic H1N1 in the first wave of infection in regions with a high incidence, ten times more than estimated from clinical surveillance.”
The smaller the transmission potential was, the longer it took to compare the estimated CFR against the cut-off value. It may take longer than a few months to derive the CFR with sound uncertainty bounds, and thus, the very early public health response may not be able to be based on the CFR.
• Highlighted potential value and limitations during pandemic response
  – Refine understanding of what is realistic to expect from modeling during pandemic response
• Identified critical data needs to make optimal use of mathematical models
  – More tangible benefits in pandemic response if data timeliness and quality can be improved
• Develop decision algorithms based on partial data (CDC 2007)
2009 H1N1 Outbreak: Antiviral Rx

- Adjust strategy from aggressive outbreak-long prophylaxis for certain high-risk groups (I.e. HCW)
- Revise to emphasize rapid treatment of ill persons and PEP for high risk
2009 H1N1 Outbreak: Antiviral Rx Challenges

• Unequal antiviral drug stockpiles across state and local jurisdictions
  – Some regions provided public access to oseltamivir from county stockpile, others did not

• Inadequate supply in private sector (esp. spring)
  – Inadequate supply of pediatric formulation

• Inability to provide antiviral drugs at POC for prompt treatment on community-wide scale

• Limitations of current antiviral drugs:
  – Effectiveness, timing of administration, resistance
  – Need to explore potential benefit of anti-inflammatory and immunomodulatory drugs for severe influenza

Many healthcare facilities (esp. ED, primary care) overloaded
- Demand for testing and treatment drove up visits
- Lack of standardized triage strategy and tools, clinical testing and treating algorithms
- ICUs stressed (surge capability): Critically ill patients required complex and resource intensive therapies

Shortages of critical supplies
It will be necessary for medical providers to **triage** and treat patients in a manner that affords each the best chance of survival and recovery within the limits of available resources.

- **Goal:** provide care and allocate scarce equipment, supplies, and personnel in a way that saves the largest number of lives.

- Planning should include thresholds for **altering triage algorithms** and otherwise optimizing the allocation of scarce resources.
2009 H1N1: Healthcare System Response

Opportunities

Crisis Standards of Care: A Systems Framework for Catastrophic Disaster Response

Released: March 21, 2012
Type: Consensus Report
Topics: Health Care Workforce, Health Services, Coverage, and Access, Public Health, Quality and Patient Safety
Activity: Guidance for Establishing Standards of Care for Use in Disaster Situations
Board: Board on Health Sciences Policy
Do we really need to wear these things?

Yep.

Nope.

I mean, maybe…
2009 H1N1: Healthcare System Response
Infection Control/PPE

- Conflicting guidelines regarding respiratory protection = confusion
- N95 recommendation difficult to implement, poor buy-in from ID and IC specialists
- Implications for exclusion and PEP for HCW after *unprotected exposure* (N95/PAPR not used)
- Shunted patients from outpatient clinics to ED
- Shortages of masks, respirators
• Relative contributions of droplet and aerosol transmission remain unknown.
• Relative effectiveness of different methods of PPE remain unknown.
• Numerous areas where additional expedited research needed.
Fighting Deadly Flu, Mexico Shuts Schools

By MARC LACEY and DONALD G. McNEIL Jr.
Published: April 24, 2009

MEXICO CITY — Mexican officials, scrambling to control a swine flu outbreak that has killed as many as 61 people and infected possibly hundreds more in recent weeks, closed museums and shuttered schools for millions of students in and around the capital on Friday, and urged people with flu symptoms to stay home from work.

May 1st, 2009 CDC guidance

- Communities with lab-confirmed cases of influenza A H1N1 consider adopting school dismissal and childcare closure measures, including closure for up to 14 days depending on the extent and severity of illness.
CDC no longer recommends that communities with a laboratory-confirmed case of Influenza A H1N1 consider adopting school dismissal or childcare closure measures. With the modified policy being issued today, CDC no longer recommends that communities with a laboratory-confirmed case of influenza A H1N1 consider adopting school dismissal or childcare closure measures. Rather, in line with policies being undertaken in Seattle, New York and Canada, CDC has modified its policy to recommend implementation of measures that focus on keeping all students, faculty and staff with symptoms of influenza out of schools and childcare facilities during their period of illness and recuperation, when they are potentially infectious to others.
Substantial additional preparation and planning is necessary if school closures are to be successfully implemented.

Communities not prepared for widespread/sustained closures:
- Support systems for students/families not in place
- No federal meal programs when schools close
- Lack of plans for continuing (“distance”) education after closure
- Students gathering out of school
- Economic costs for families and society
- Equity: Social justice and ethical issues

Additional evidence needed to determine optimal strategies for and benefits of proactive and reactive school closure.

Value of frequent re-assessment of epidemiology and corresponding modification recommendations.

• Priority objectives
  • Protecting those who are essential to the pandemic response and provide care for persons who are ill
  • Protecting those who maintain essential community services
  • Protecting children, and
  • Protecting workers at greater risk of infection due to their job

• Vaccine not expected to be available during first wave

Vaccination tiers and target groups for a severe pandemic

(http://www.pandemicflu.gov/vaccine/allocationguidance.pdf)
Groups Recommended to Receive Novel H1N1 Influenza Vaccine (Target Population) – June, 2009

- Pregnant women
- People who live with/care for children <6 mo. of age
- Healthcare & emergency medical services personnel
- All people from 6 months - 24 years of age
- Persons aged 25 - 64 years who have health conditions associated with higher risk of medical complications from influenza.

- These five target groups comprise an estimated 159 million persons in the United States
- State and local health jurisdictions had flexibility in application of ACIP guidance

*Use of Influenza A (H1N1) 2009 Monovalent Vaccine. Recommendations of the Advisory Committee on Immunization Practices (ACIP), 2009. MMWR August 21, 2009 / 58(Early Release);1-8*
Groups Recommended to Receive Novel H1N1 Influenza Vaccine First When Supply is Limited

- Pregnant women
- People who live with/care for children <6 months of age
- Health care and emergency medical services personnel with direct patient contact
- Children 6 months through 4 years of age
- Children 5 through 18 years of age who have chronic medical conditions
- This subset of the five target groups comprises approximately 42 million persons in the United States

Use of Influenza A (H1N1) 2009 Monovalent Vaccine. Recommendations of the Advisory Committee on Immunization Practices (ACIP), 2009. MMWR August 21, 2009 / 58(Early Release);1-8
Not in ACIP subgroups to consider for vaccination first in shortage
CDC says not worried about H1N1 vaccine supply

WASHINGTON | Fri Jul 17, 2009 5:40pm BST

(Reuters) - The United States is not worried about being able to secure enough vaccines against the new H1N1 swine flu virus, a U.S. Centers for Disease Control and Prevention official said on Friday. "We’re on track and not concerned about meeting expectations" (CDC)
US Expects Far Fewer Swine Flu Shots in October

US: Far fewer swine flu shots now expected by October, extending vaccinations another month

By LAURAN NEERGAARD AP Medical Writer
WASHINGTON August 17, 2009 (AP)

The U.S. won't have nearly as much swine flu vaccine ready by mid-October as long predicted — 45 million doses instead of the anticipated 120 million, a federal official said Monday.

It's not a shortage but a delay, Health and Human Services spokesman Bill Hall said. More will

“It’s not a shortage but a delay” (HHS)
As soon as a vaccine is available, try to get it for everyone in your family. (CDC)
WASHINGTON, Oct. 7, 2009

Sebelius: Americans Must Get Swine Flu Vaccination

HHS Sec'y Sebelius Exhorts Americans To Get Their Swine Vaccine, Calls It 'safe And Secure'

(AP) Health and Human Services Secretary Kathleen Sebelius is urging people to get their swine flu vaccine, calling it "safe and secure."

Sebelius (seh-BEEL'-yuhs) made the rounds of morning network news shows Wednesday to renew a federal appeal for widespread vaccination, saying a quick response is vital because H1N1 already is spreading in some areas.

Asked on NBC's "Today" program about those who are reluctant to get the vaccine, Sebelius said "the adverse effects are minimal." She said production is ahead of schedule and a full supply should be available by the end of the month.
2009 H1N1 Vaccine Supply & Influenza Activity
King County, WA: Spring-Fall, 2009

Weekly Count of ED Visits for Influenza-Like Illness
By Age Group

Legend
- < 2 yrs
- 2 to 4 yrs
- 5 to 17 yrs
- 18 to 44 yrs
- 45 to 64 yrs
- 65+ yrs

Vaccine received for 17% of ACIP target population when outbreak peaked 10/31*

* HCW = 9% of target pop

Week Ending

ALLHOSPITALS, Last Updated Nov 22, 2009
Will Safety Fears Hurt Swine Flu Vaccinations?

Concerns Over Thimerosal, Expedited Approval Process Ignite Worries in Some

By RADHA CHITALE and DAN CHILDS
ABC News Medical Unit

JULY 30, 2009

With the U.S. Centers for Disease Control and Prevention hoping to have 120 million doses of H1N1 swine flu virus vaccine ready before flu season this fall, some are raising concerns over what they see as an effort to rush the drug through safety trials.
Some parents say they are concerned about side effects from the new vaccine...while others say swine flu doesn't amount to any greater health threat than seasonal flu.
Estimated influenza A (H1N1) 2009 vaccination coverage
BRFSS and National 2009 H1N1 Flu Survey, end of January 2010

<table>
<thead>
<tr>
<th>Group</th>
<th>Median Coverage</th>
<th>% (range)</th>
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</thead>
<tbody>
<tr>
<td>Children 6 mo.-17 yr</td>
<td>36.8</td>
<td>(21-85)</td>
</tr>
<tr>
<td>Adults ≥18 yr</td>
<td>20.1</td>
<td>(9-34)</td>
</tr>
<tr>
<td>ACIP initial target group</td>
<td>33.2</td>
<td>(19-58)</td>
</tr>
<tr>
<td>Adults 25-64 yr, HR</td>
<td>25.2</td>
<td>(10—47)</td>
</tr>
</tbody>
</table>

MMWR / April 2, 2010 / Vol. 59 / No. 12
2009 H1N1 and Seasonal Influenza Vaccine Coverage
Health-care Personnel, US, August 2009-JAN 2020

Seasonal coverage = 62%

2009 H1N1 coverage = 37%
### 2009 H1N1 Pandemic Vaccine Effectiveness

<table>
<thead>
<tr>
<th>Age (Years)</th>
<th>%Adjusted Vaccine Effectiveness&lt;sup&gt;1&lt;/sup&gt; (95% Confidence Interval)</th>
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<tbody>
<tr>
<td><strong>Any pandemic vaccine</strong></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>57.9 (32.4, 73.7)</td>
</tr>
<tr>
<td>0.5–9</td>
<td>50.8 (–8.4, 77.7)</td>
</tr>
<tr>
<td>10–49</td>
<td>59.0 (14.7, 80.3)</td>
</tr>
<tr>
<td>≥50</td>
<td>22.3 (–134.8, 74.3)</td>
</tr>
<tr>
<td><strong>Inactivated pandemic vaccine</strong></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>58.6 (26.2, 76.7)</td>
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<tr>
<td>0.5–9</td>
<td>15.9 (–107.7, 66.0)</td>
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<tr>
<td>10–49</td>
<td>77.2 (24.8, 93.1)</td>
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<td>≥50</td>
<td>22.2 (–135, 74.3)</td>
</tr>
<tr>
<td><strong>Live attenuated pandemic vaccine</strong></td>
<td></td>
</tr>
<tr>
<td>2–49</td>
<td>60.6 (12.3, 82.3)</td>
</tr>
<tr>
<td>2–9</td>
<td>81.9 (13.6, 96.2)</td>
</tr>
<tr>
<td>10–49</td>
<td>26.4 (–91.3, 71.7)</td>
</tr>
</tbody>
</table>

The acute shortage of swine-flu vaccines, coupled with different distribution plans by local health authorities...has created widespread confusion and frustration among Puget Sound area residents.

“\textit{The acute shortage of swine-flu vaccines, coupled with different distribution plans by local health authorities...has created widespread confusion and frustration among Puget Sound area residents.}”
COMMENTARY

The Institute of Medicine’s Forum on Medical and Public Health Preparedness for Catastrophic Events: Regional Workshop Series on the 2009 H1N1 Influenza Vaccination Campaign

Clare Stroud, PhD; Bruce M. Alkemeyer, PhD; Jay C. Butler, MD; Jeffrey S. Duchin, MD

ABSTRACT

In response to the 2009 H1N1 influenza pandemic, public health authorities launched an ambitious vaccination program to protect tens of millions of Americans from the virus. In April and May 2010, the Institute of Medicine Forum on Medical and Public Health Preparedness for Catastrophic Events hosted a series of 3 regional workshops to examine the 2009 H1N1 vaccination campaign. The workshops brought together stakeholders involved in distributing and dispensing H1N1 vaccine to discuss successes and challenges and to identify strategies to improve future vaccination programs and other medical countermeasure dispensing campaigns. On the basis of the presentations and the discussions that followed, several themes and opportunities for future efforts were identified in the following areas: vaccine supply and demand; state and local implementation of Centers for Disease Control and Prevention/Advisory Committee on Immunization Practices recommendations; including prioritization for vaccination; vaccine formulations and priority groups; opportunities for developing partnerships; opportunities to increase seasonal vaccination rates among pregnant women and health care workers and to increase acceptance of live attenuated nasal spray vaccine; standardization and improvement of immunization information management systems; opportunities to simplify, systematize, and automate processes and practices; and research needs and opportunities.

Key Words: H1N1 influenza, pandemic, vaccination campaign

In response to the 2009 H1N1 influenza pandemic, public health authorities launched an ambitious vaccination program to protect tens of millions of Americans from the virus. The goal was to ensure that everyone who wanted to be vaccinated was able to do so. Providing 1 dose of vaccine to high-risk individuals is not considered to be a strategy to prevent the spread of the virus.
2009 Influenza A H1N1 Vaccination Program

Challenges and Opportunities

• Wide variation in 2009 H1N1 vaccination rates among states suggests opportunities for improvement
• Systems for large scale, rapid distribution of medical countermeasures through the healthcare delivery system are not adequately established or transparent enough (and remain largely untested)
  – Increase transparency of allocation and distribution process (to healthcare providers and public)
  – Improve systems to track utilization of vaccine and use
  – Simplify vaccine ordering process
  – Enhance networks of private providers, pharmacies, non-traditional vaccination venues
  – Indications for use of similar vaccine products should be harmonized during an emergency as long as it is safe to do so
## Inactivated, Injectable Influenza Vaccine

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Age</th>
<th>Dose—Presentation</th>
<th>Number of Doses</th>
<th>Route–Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>sanofi pasteur</td>
<td>6 through 35 months(^1)</td>
<td>0.25 mL—prefilled syringe(^1)</td>
<td>2(^2)</td>
<td>Intramuscular(^3)</td>
</tr>
<tr>
<td></td>
<td>36 months and older</td>
<td>0.5 mL—prefilled syringe</td>
<td>1 or 2(^2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6 months and older</td>
<td>Dose per age—multidose vial</td>
<td>1 or 2(^2)</td>
<td>Intramuscular(^3)</td>
</tr>
<tr>
<td>Novartis Vaccine</td>
<td>4 years and older</td>
<td>0.5 mL—multidose vial</td>
<td>1 or 2(^2)</td>
<td>Intramuscular(^3)</td>
</tr>
<tr>
<td>CSL</td>
<td>18 years and older</td>
<td>0.5 mL—prefilled syringe</td>
<td>1</td>
<td>Intramuscular(^3)</td>
</tr>
<tr>
<td>CSL</td>
<td>18 years and older</td>
<td>0.5 mL—multidose vial</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^1\) Children age 6 through 35 months should receive 0.25 mL vaccine per dose. Children age 36 months through adults should receive 0.5 mL vaccine per dose. See footnote 2 to determine number of doses.

\(^2\) Based on currently available information, children 6 months through 9 years who are receiving injectable influenza A (H1N1) 2009 Monovalent vaccine should receive two doses of vaccine separated by approximately 4 weeks.

\(^3\) Children 6 months through 2 years of age should be vaccinated in the anterolateral aspect of the thigh. Older children and adults should be vaccinated in the deltoid muscle if muscle mass is adequate. The anterolateral aspect of the thigh may be used as an alternate.

## Live Attenuated Nasal Spray Influenza Vaccine (LAIV)

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Age</th>
<th>Dose—Presentation</th>
<th>Number of Doses</th>
<th>Route</th>
</tr>
</thead>
<tbody>
<tr>
<td>MedImmune</td>
<td>2 through 49 years if healthy and non-pregnant</td>
<td>0.2 mL—Spray ½ of dose into each nostril as indicated on the syringe.</td>
<td>1 or 2(^4)</td>
<td>Intranasal</td>
</tr>
</tbody>
</table>

\(^4\) Based on currently available information, healthy children 2 through 9 years of age who are receiving live attenuated influenza A (H1N1) 2009 Monovalent vaccine should receive two doses separated by approximately 4 weeks.

For more information call **800-CDC-INFO** (800-232-4636) Website [www.cdc.gov/flu](http://www.cdc.gov/flu)
• National child immunization (VFC) program, administered by public health programs, was backbone of H1N1 vaccine distribution system
• Surge in new HCP, primarily adult immunizers, enrolled to administer H1N1 vaccine
  – 64% of H1N1 providers new to system during outbreak
  – New vaccinators unfamiliar with working with public health: immunization registry, communication, ordering and accountability procedures
• No adult vaccine program analogous to VFC
U.S. Immunization Program Funding

• Federal VFC program budget in 2012 = $4.0 billion
• Discretionary Section 317 program budget = $562 million
  – Supports state/local immunization infrastructure and operational costs as well as vaccines public health departments provide to individuals not eligible for VFC, including adults
• In 2009, Americans spent $4.2 billion on Halloween & Easter candy*

2009 H1N1 Vaccination Program
Challenges and Opportunities

• Variability in interpretation and application of ACIP prioritization guidance led to regional inconsistencies in vaccination strategies:
  – Target population vs. subgroups vs. non-target
  – Sequential vs. simultaneous vaccination
  – Group with highest mortality* (adults with high-risk conditions) not in ACIP subgroups for initial vaccination when supply limited

• Consider benefits of increased standardization of implementation of prioritization recommendations

• Explore use of mathematical modeling to inform optimal vaccine allocation strategies at different time points of an epidemic

*outside of infants
• With low vaccine supplies, high-risk groups should be prioritized but high transmission groups should be vaccinated with larger quantities of vaccine.
• There is a threshold in the time when a switch in the optimal strategy occurs, after which, vaccine would be more effective if allocated directly to the high-risk groups.
• Pandemic H1N1 peaked in the US in early OCT 2009, when vaccination with limited supplies of vaccine began. As a result, most vaccine was administered well after the peak. The mass vaccination of children that occurred had a minimal effect on protecting others and reducing general morbidity in the population.
“…epidemic data can be used…to give a criterion when initial prioritization of a population group with a sufficiently high risk of epidemic-associated mortality is advisable over the policy of prioritizing a core group with a relatively low risk of mortality but fuelling transmission in the community.”
CDC Public Health Emergency Preparedness Funding
FY2004 through FY2013*
(27.8% Total Cut in Funding)

Dollars in Millions

FY2004: $850
FY2005: $863
FY2006: $766
FY2007: $897
FY2008: $705
FY2009: $689
FY2010: $698
FY2011: $614
FY2012: $620
FY2013*: $614

Courtesy of NACCHO
“If it were painful, could I do this?”
H1N1 flu 'pushing hospitals to their limit'

10/27/2009

By Steve Sternberg, USA TODAY

Baltimore — To Mitchell Goldstein, the flood of sick children seemed endless. Day after day, nearly three times as many kids as usual streamed into the rainbow-colored pediatric emergency room at Johns Hopkins Hospital, sniffing and feverish, worried parents hovering.

The press of children with swine flu was so relentless that doctors opened an annex in a hospital dining room to handle the overflow. “Our worst day” was Sunday, Oct. 11, says Goldstein, one of the ER doctors. “We had 15 to 20 patients an hour. It was 24/7. There wasn’t a lull.”

“If we hadn't planned for this surge, it could have produced a deadly increase in volume that we couldn't have handled”

Registered nurse Corrina Valenti prepares an H1N1 flu vaccine for at-risk health care workers at Johns Hopkins Hospital in Baltimore on Wednesday.

The scenes at Johns Hopkins are being repeated at hospitals in Denver and Duluth, Seattle and San Diego, as waves of flu patients arrive at their doors, doubling their emergency room volume. Just as significant is the effect on intensive care units: A